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NOTES ON THE HANDS AND FEET OF AMERICAN NATIVES

By H. F. C. TEN KATE

THE present article was originally intended to form part of a series of papers which I published, and which are further going to appear in *L'Anthropologie* under the general title of "Mélanges anthropologiques." The great difficulties and unavoidable tardiness of publication of these memoirs, however, in consequence of the war, induces me to present the following article to the *American Anthropologist*, although in a somewhat different form than first intended, and as I did previously with another contribution in relation to the "Mélanges."¹ Herewith the work, of which the first number appeared in 1913, comes at last to an end.

The following data pertaining to hands and feet of North and South American Indians, Carbugres and Bush Negroes, both natives of Surinam, are based upon my own observations and measurements, mostly made and taken in the field, mainly in the years 1883, 1885-86, and 1888. With the exception of a few figures concerning the stature and the indices of hands and feet, all these data are here published for the first time.

I am well aware of the scantiness of my material as it is given here, but it should be studied in connection with the other somatological data which, as I said before, have been or are to be published elsewhere and of which it forms the necessary supplement.² Besides measurements and observations on hands and feet of exotic races, as treated in the present paper, as far as I know, are comparatively

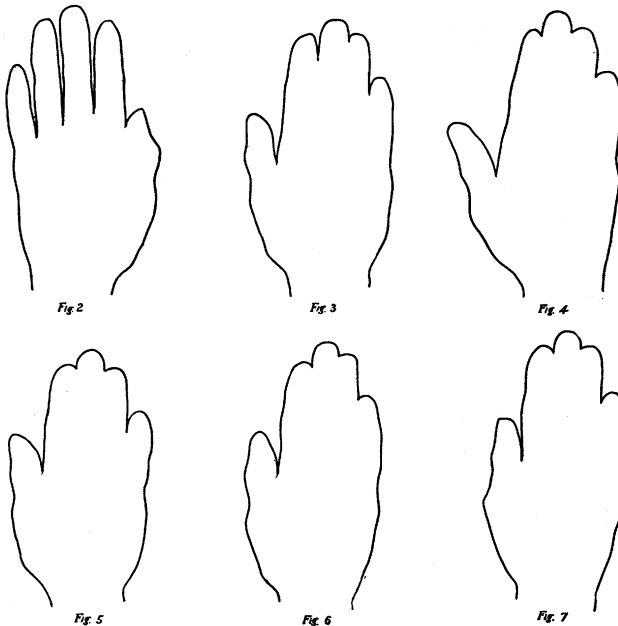
¹ "Dynamometric Observations on Various Peoples," *American Anthropologist* (N. S.), vol. 18 (1916).

² See for the North American Indians in particular my "Somatological Observations on Indians of the Southwest," *Journal of American Ethnology and Archaeology*, vol. III (Boston, 1892), and "Mélanges anthropologiques," no. VI; for the natives of Guayana, *Revue d'Anthropologie* (Paris, 1887), pp. 44 seq. and *Encyclopaedie van Nederlandsch West-Indië* (The Hague and Leiden, 1914-17), pp. 113-116, 165-166; for the Guayaqui Indians of Paraguay, *Anales del Museo de La Plata, Seccion antropologica*, vol. II (La Plata, 1897).

rare, and our knowledge of this subject is apparently still rather fragmentary. Hence my venture to publish these notes for what they are worth.

The present study is chiefly based upon the outlines, on paper, of 44 hands and 42 feet, belonging to 54 subjects, namely 31 North American Indians, 18 South American Indians, and 5 Carbugres and Bush Negroes. Moreover I obtained the length of the fingers of 6 Navajo and 18 Zuñi Indians by direct measurement with the *compas glissière*.

All these outlines were drawn, according to the instructions of



FIGS. 2-7.—Tracings of hands ; size $\frac{3}{16}$.

French anthropologists, with a pencil specially adapted for this purpose (*crayon approprié*). On the outlines thus obtained, the measurements were taken.¹ To avoid misunderstanding, the following, however, should be remembered. The transversal diameter of the hand is the metacarpo-digital line and at the same time the greatest breadth of the hand. The longitudinal diameter

¹ Cf. Topinard, *Éléments d'Anthropologie générale*, pp. 1135-1136.

of the foot represents the maximum length, regardless whether the first or the second toe is the longest. Thus this measure is frequently one of projection. The transversal diameter of the foot follows the metatarso-phalangean line, and gives at the same time the greatest breadth of the foot. Moreover it should be borne in mind that as a rule there is a slight difference between the measurements taken on the outlines and those taken directly on the living subjects. This refers in particular to the diameters of length of hands and feet. I think that on the whole the figures resulting from outline measurements are the most reliable of the two methods. My measurements were mostly taken with the *compas glissière*, except when the feet were too long for this instrument. In such cases I measured the greatest length with the *glissière anthropométrique* of Topinard, constructed by Collin. The figures of absolute measurements represent millimeters. Nearly all the anatomical and morphological details mentioned in the succeeding tables and discussed here, are inferred from the outline drawings. The accompanying illustrations are selected from my collection of outline drawings and more or less representative of the different hand and foot types found among the subjects under discussion.

All these subjects are apparently normal. The great majority consists of adults, presumably between twenty and forty-five years of age. There are four or five cases presumably from sixteen to nineteen years among them, and only one old subject. With the exception of three cases of very young subjects, approximately from ten to fifteen years, all the others are included in the averages, as far as these have been calculated.

I have divided my material into three groups, each of which will be discussed separately. Finally an attempt at comparison between these groups has been made as far as feasible with the scanty material at my disposal.

NORTH AMERICAN INDIANS

From Table I it will be seen that on the average the index of hands and feet is higher among the males than among the females; in other words the former have larger hands than the latter.

TABLE I
MALES

No.	Tribe	Hands					Feet					Re- marks											
		Right or Left	Stature	Greatest		Index	Length	Breadth	Remarks	Right or Left	Greatest		Index	Longest Toe		Interstices Be- tween Toes							
				Length	Breadth						Length			Breadth	Length	Breadth	I/II	II/III	III/IV				
1	Maricopa...	L	1.786	198	90	45.4	II.0	5.0	Fig. 2					L	270	105	44.0	15.6	5.8	I-II	+	...	
2	Mohave...	R	...	201	89	44.2	...	...	...					L	257	104	40.4	...	...	I	+	...
3	"	R	1.850	210	87	41.4	II.4	4.7	...					L	270	110	40.7	14.6	5.9	I	+	...	
4	Chemehuevi	R	...	197	81	41.1	...	...	...					L	267	111	41.5	...	...	I	+	Fig. 8
5	"	R	...	...	...	...	...	...	...					L	262	107	41.9	...	...	I	...	Fig. 9
6	Comanche	R	...	190	85	44.7	...	...	...					R	249	104	41.7	14.6	6.1	II	+	...
7	Yaqui...	L	1.695	187	84	44.9	II.0	4.9	Approximate stature					R	266	102	38.3	...	...	I	+	...
8	"	...	...	...	...	...	...	...	...					R	262	104	39.6	...	...	II	...	Fig. 10
9	"	...	...	...	...	...	...	...	...					R	248	113	45.1	...	...	I	...	Fig. 11
10	"	...	...	...	...	...	...	...	...					...	...	...	...	...	...	...	...	...
11	Pima...	R	1.730	182	85	46.7	IO.5	4.9	...					...	...	...	...	...	...	...	...	...
12	"	R	1.640	181	82	45.3	II.0	5.0	...					R	262	104	39.6	...	...	...	...	...
13	"	L	1.830	212	90	42.3	II.5	4.9	...					...	...	...	...	...	...	...	...	...
14	"	...	...	...	...	...	...	...	...					R	270	100	39.9	...	...	II	...	...
15	"	R	1.720	189	83	43.9	IO.9	4.8	...					...	...	...	...	...	...	...	...	...
16	"	R	1.700	201	78	38.8	II.8	4.5	...					...	...	...	...	...	...	...	...	...
17	"	R	1.712	204	80	39.2	II.9	4.6	...					...	...	...	...	...	...	...	...	...
18	"	R	1.754	199	76	38.0	II.3	4.3	...					R	258	96	37.2	14.7	6.7	I	...	...
19	"	R	1.640	182	82	45.0	II.0	5.0	Fig. 3					R	247	96	38.8	14.4	5.9	I	+	III/IV Fig. 12	
20	"	R	1.662	192	87	45.3	II.5	5.2	Fig. 4					R	250	105	42.0	15.6	6.3	I	...	...
21	Papago...	L	...	183	78	42.6	...	...	...					...	...	...	...	...	...	...	...	...
22	"	L	...	184	76	41.3	...	...	...					...	...	...	...	...	...	...	...	...
23	"	...	...	...	...	...	...	...	...					L	228	103	44.6	...	...	I	...	...
General average		...	1.743	193.7	83.1	42.6	II.2	4.6	Approximate stature					...	257.4	104.2	41.1	14.9	6.1

TABLE I—Continued
FEMALES

No.	Tribe	Hands						Feet						Re- marks								
		Right or Left	Stature	Greatest		Index	Length		Breadth	Remarks	Right or Left	Greatest			Index	Length		Breadth	Longest Toe	Interstices Be- tween Toes		
				Length	Breadth		in Rela- tion to Stature = 100	Length				Breadth	I/II			II/III	III/IV					
1	Maricopa....	R	1.600	179	74	41.3	11.1	4.6	.....	R	254	95	37.3	15.9	5.9	.....	.....	.....	.....	.....
2	Pima.....	R	1.562	183	74	40.4	11.0	4.6	.....	L	236	93	39.4	15.1	5.9	.....	.....	.....	.....	.....
3	".....	R	1.610	179	74	41.3	11.1	4.5	.....	R	231	96	41.1	14.3	5.9	.....	.....	.....	.....	.....
4	".....	L	1.598	186	80	44.3	11.1	5.0	.....	L	244	100	40.8	14.6	6.2	.....	.....	.....	.....	.....
5	Papago....	R	.....	183	76	41.5	.....	.....	.....	R	241	93	38.6	.....	.....	.....	.....	.....	.....	Fig. 13
6	".....	R	.....	184	79	42.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	".....	R	.....	176	74	42.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
General average . . .		...	1.592	181.4	75.8	41.9	11.0	4.6	.....	...	241.2	95.4	39.4	14.9	5.9	.....	.....	.....	.....	.....
8	Chemehuevi.	R	.....	170	76	44.7	.....	.....	Approximate age 14-15	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

The ratio of the hand length and hand breadth to the stature (= 100) is practically the same in both sexes. As for the centesimal ratio of the feet measures to stature, there is only a difference in the relative breadth of the feet, which is larger among the males.

As could be expected, as a rule in both sexes the fourth finger is longer than the second or forefinger, but in two cases in twenty-five, or 8 per cent., both these fingers are of equal length. In two other cases, or equally 8 per cent., the forefinger is longer than the fourth finger. In this connection I can mention that the twenty-four Navajo and Zuñi Indians of both sexes, which I measured at Fort Defiance and Pueblo de Zuñi, present the following dispositions: second and fourth finger of equal length in two cases, or 8.3 per cent.; second finger longer than fourth in six cases, or 25 per cent.

The average absolute length of the three middle fingers of said Indians is as follows:

	II, Millimeters	III, Millimeters	IV, Millimeters
5 male Navajo.....	89.8	101.2	94.2
10 male Zuñi.....	84.7	94.3	87.2
8 female Zuñi.....	79.6	88.2	83.1

The length of these fingers of a Navajo woman is respectively 91, 98, and 87 mm.

Taking all the North American Indians of the different tribes together, we find that the average difference in length between the second and fourth finger is 4.6 mm. for the males and 2.3 for the females. The greatest individual difference, as presented by a Mohave, attained 13 mm.

Even a superficial inspection of the outlines of the hands and feet shows that there are morphologically two principal types or forms among them, besides one or two forms which might be called intermediate or mixed forms; and of course the individual variations. Thus it is easy to distinguish a long and narrow, or slender, and a short and broad, or heavy type. This applies of course also to the South American Indians and other natives.

The fingers belonging to the first-mentioned type are comparatively thin and well formed; those of the second type thick and

clumsy. It seems that the thumb of the first type, in relation to the other fingers, is longer than the thumb of the second type, where it is sometimes strikingly short and heavy.

The distribution of the various hand forms among the Indians of the above table is as follows:

25 Hands	17 Males	8 Females	Total Percentage
Long.....	11	7	72
Short.....	2	—	8
Intermediate.....	4	1	20

As regards the feet, as a rule the first toe is the longest. In one case, or 5.2 per cent., the first and second toe are of equal length. The second toe exceeds the first in three cases, or 15.7 per cent.

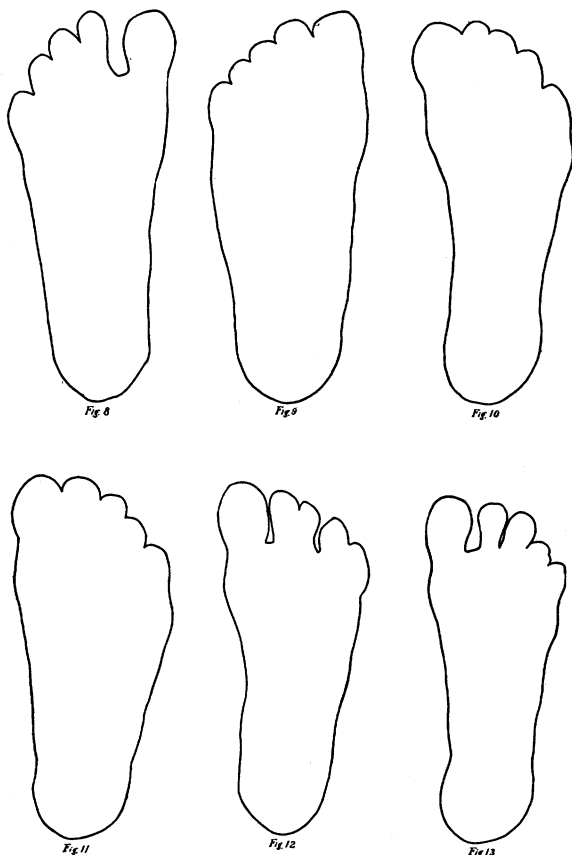
The great or first toe tends outward in four cases, or 21 per cent., among which only once in a more or less marked degree. In two cases, or 10.5 per cent., there is a deviation of the toes, specially marked in the third to fifth. These toes, however, while they are more or less spread out like a fan, point outward, contrary to what usually happens in such cases.

In two cases, or 10.5 per cent., a marked concave incurvation or bent of the inward margin of the foot occurs. This incurvation is situated between the metatarso-phalangean line and the calcanean portion of the foot. In both cases the first toe is more or less tended outward. This peculiar configuration of the inward outline and part of the sole, is especially marked in the foot of a Yaqui and of a Pima Indian (figs. 10 and 12). It frequently has been observed, as well by myself as by others, among Malays and Indonesians, and occurs also to a certain degree in the so-called *carrasco*-foot of the natives of the Philippine Islands.

Interstices between the different toes occur in nine individual cases, or 47.3 per cent. In three of these cases different interstices are found on the same foot.

Morphologically, the differences of the feet are more marked than those of the hands. This greater difference lies not only in the variety of configuration of the inward margin of the foot and of the disposition of the toes, but also in the difference in breadth

of the metatarso-phalangean or anterior portion and that of the calcanean or posterior part of the foot. In the long and narrow type this difference is as a rule comparatively slight, while it is generally more marked in the short and broad type. For obvious



FIGS. 8-13.—Tracings of feet ; size $\frac{3}{16}$.

reasons this difference in breadth is caused that the foot index, or centesimal ratio between maximum length and breadth, does not necessarily express the type of foot. In some cases, however, a certain degree of correlation between the two exists.

The principal forms of feet among the North American Indians are thus distributed:

19 Feet	14 Males	5 Females	Total Percentage
Long.....	9	4	68.4
Short.....	2	—	10.5
Intermediate.....	3	1	21.0

SOUTH AMERICAN INDIANS

The main conclusions we can draw from Table II are the following.

The hand and foot index of the males is considerably higher than that of the females; in other words the former have larger hands and feet than the latter.

The length and breadth of the hand and the length of the foot in relation to the stature ($= 100$) is nearly the same in both sexes, while the breadth of the foot of the males exceeds that of the females. With the exception of one case in fourteen, 7.1 per cent., the fourth finger in both sexes is always longer than the second.

The average difference in length of the second and fourth finger is 4.2 mm. among the males and 3.5 among the females.

What I have said before with reference to the relative shortness of the thumb applies more particularly to the South American Indians. At least those of the broad hand type have a very short thumb.

As for the different forms of hand, their distribution is as follows:

14 hands	8 Males	6 Females	Total Percentage
Long.....	2	4	42.8
Short.....	2	2	28.5
Intermediate.....	4	—	28.5

In the majority of cases the first toe is the longest. In two cases, 11.1 per cent., the first and second toe are of the same length. In four cases, or 22.2 per cent., the second toe is the longest.

The great toe tends outward in eleven cases, or 61.1 per cent., six of which, though strongly marked, never reach the degree which is found in the *carrasco*-foot and among the Negritos. Neither is the fan-like spreading or tending sideward of the other toes so striking, although it occurs in two cases, 11.1 per cent.

The concave incurvation, mentioned among my North American subjects, occurs three times, or 17.2 per cent., among the South American Indians (*cf.* fig. 14).

TABLE II
MALES

No.	Tribe	Hands						Feet						Remarks							
		Right or Left	Stature	Greatest		Index	Length		Breadth	Right or Left	Greatest		Index		Length		Breadth	Longest Toe	Interstices Between Toes		
				Length	Breadth		Length	Breadth			Length	Breadth			in Relation to Stature = 100	I/II			II/III	III/IV	
1	Carib.....	R	1.535	175	78	44.5	11.4	5.0	.....	R	220	95	43.1	14.9	6.1	I-II	.....	.....	.....	.....
2	"	R	1.560	180	81	45.0	11.5	5.1	.....	R	230	92	40.0	14.1	5.8	I	.....	.....	.....	.....
3	"	L	1.620	186	75	45.6	11.4	4.5	.....	L	243	103	42.3	15.0	6.5	I	.....	.....	.....	.....
4	Macusi.....	R	1.600	185	81	43.7	11.5	5.0	.....	R	251	110	43.8	15.6	6.8	II	.....	.....	.....	.....
5	Akawoi.....	L	1.610	184	78	42.3	11.5	4.8	.....	R	234	104	44.4	14.5	6.4	I-II	.....	.....	.....	.....
6	Arecuna.....	R	1.595	175	74	42.2	10.9	4.6	.....	R	233	105	44.9	14.6	6.5	I	.....	.....	.....	Fig. 14
7	Arawak.....	R	1.515	170	76	44.7	11.2	5.1	.....	R	215	94	43.7	14.1	6.1	I	.....	.....	.....	.....
8	"	.....	1.502	.....	.....	.....	.....	.....	.....	L	239	101	41.4	15.3	6.5	I	.....	.....	.....	.....
9	"	.....	1.590	.....	.....	.....	.....	.....	.....	L	241	107	44.3	15.1	6.0	II	.....	.....	.....	.....
10	Waru.....	R	1.585	171	76	44.4	10.7	4.7	.....	R	237	103	43.4	14.9	6.4	I	.....	.....	.....	.....
General average.		...	1.577	178.2	77.3	44.0	11.2	4.8	.....	...	234.3	101.4	43.1	14.8	6.3	.....	.....	.....	.....	.....
11	Guayaqui.....	.....	1.324	.....	.....	.....	.....	.....	.....	R	218	89	40.8	16.4	6.7	I	.....	.....	.....	.....
General average.		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

FEMALES

1	Carib.....	L	1.460	170	78	45.8	11.6	5.3	.....	L	219	82	37.4	15.0	5.6	I	.....
2	Akawai.....	.....	1.480	.....	.....	.....	.....	.....	.....	R	221	84	38.0	14.9	5.6	I	.....
3	"	R	1.640	172	71	41.2	10.4	4.3	.....	R	224	93	41.5	13.6	5.6	I	.....
4	Arecuna.....	R	1.505	168	70	41.0	11.1	4.6	.....	R	225	91	40.4	14.9	5.0	I	.....
5	Arawak.....	R	1.495	170	71	41.7	12.0	4.7	.....	R	226	91	40.2	15.1	6.0	II	.....
6	"	R	1.450	163	73	44.7	11.2	5.3	.....	R	204	87	42.6	14.6	6.0	II	.....
General average.		...	1.505	160.8	72.6	42.8	11.2	4.1	.....	...	210.9	88	40.1	14.6	6.0	.....	.....
7	Carib.....	L	1.280	151	67	43.6	11.7	5.0	.....	R	209	90	42.0	16.3	6.8	I	.....

The interstices between the different toes are generally much more marked and wider than among the North American Indians. The trapeziform interstice observed by Maurel¹ among the Galibis, which also is much less frequent and less developed among the Indians of North America, occurs in several cases. Figure 15 (the foot of a male Arawak of Epira on the Corentyn river) shows this curious disposition in a marked degree. Interstices generally are found in fifteen cases, or 83.3 per cent., among the Indians of the above table.

The following figures show the distribution of the different forms of feet:

18 Feet	11 Males	7 Females	Total Percentage
Long.....	—	2	11.1
Short.....	7	2	50.0
Intermediate.....	4	3	38.8

The greater prevalence, by 39.5 per cent., of the short and broad foot type among the South American Indians is only partly confirmed by the average foot index. What I have said before also applies to these Indians, and in a more marked degree. Their most frequent or typical foot has a very large metatarso-phalangean diameter in comparison with the breadth of the calcanean portion, situated behind the bi-malleolar line. Roughly speaking, seen in outline from above, this type of foot has more or less the form of a blunt wedge, the point of which is represented by the heel. Figures 15 and 16, representing the feet of an Arawak and a Warrau, are fair specimens of this type, with which the foot of a Yaqui Indian (fig. 11) can be compared.

CARBUGRES AND BUSH NEGROES

The Indian Carbugres or Carbugre Indians of Surinam are a crossbreed between Indians and Negroes. Their physical characteristics generally resemble more those of the full-blood Indians than those of the Negroes. My three subjects are of Carib-Negro extraction.

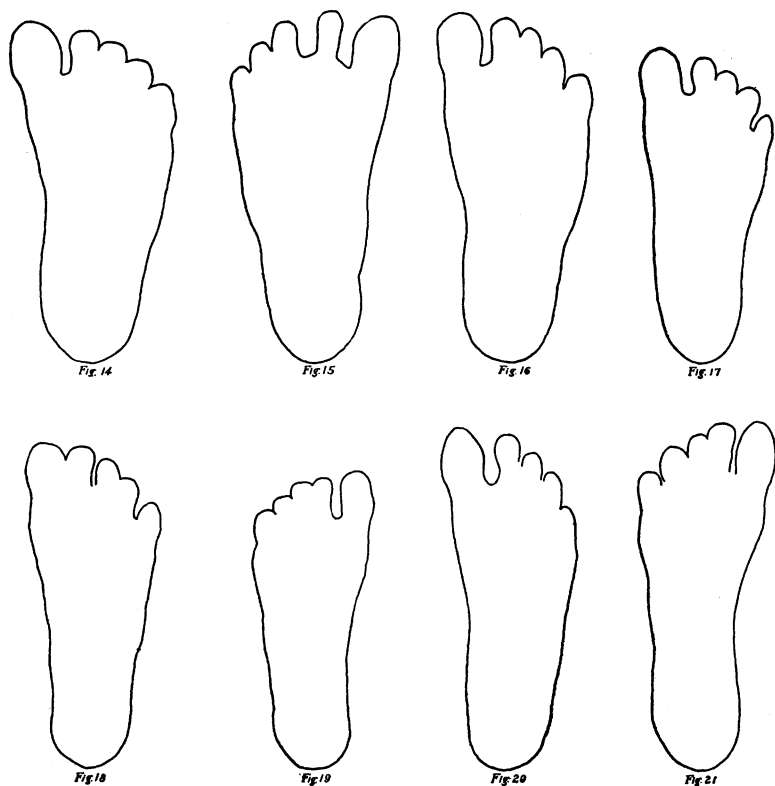
¹ Cf. *Revue d'Anthropologie* (1887), p. 53.

The general aspect of the Bush Negroes is truly Nigritic-African notwithstanding they have inhabited Surinam for generations.

No. 1 of the Table III belongs to the Beku-Musinga tribe; No. 2 to that of the Yucas.

In view of the very small number of subjects, my comment on Table III can be brief.

If we may judge from these three cases of Carbugres, their



FIGS. 14-21.—Tracings of feet; size $\frac{3}{16}$.

hands are on the average comparatively large according to the index, and both long and large in their centesimal relation to the stature.

The index of the foot is on the whole a trifle higher than that of the male Guayana Indians. Their relative breadth is the same as in my series of full-blood Indians.

TABLE III
CARBUGRES

No.	Sex.	Hands							Feet							Remarks									
		Right or Left		Stature		Greatest		Index	Length		Breadth	Remarks		Right or Left	Greatest		Index	Length		Breadth	Longest Toe	Interstices Between Toes			
									in Relation to Stature = 100									Length	Breadth			Length	Breadth	in Relation to Stature = 100	I/II	II/III	III/IV
1	Male.....	L	1.540	189	82	43.3	12.2	5.3	.....	.....	L	239	91	38.0	15.5	5.9	I	.....	.....	.....	.....	.....	.....	.....
2	".....	L	1.470	172	75	43.6	11.7	5.1	.....	.....	L	231	102	44.1	15.7	7.2	II	.....	.....	.....	.....	.....	.....	.....
3	Female.....	R	1.360	155	72	46.4	11.3	5.2	.....	Approximate age 12-14	L	208	81	38.9	15.2	5.9	I	.....	.....	.....	.....	.....	.....	Fig. 19

BUSH NEGROES

1	Female.....	R	1.525	181	73	40.3	11.2	4.7	.....	Fig. 6	R	235	87	37.0	15.4	5.7	I	.....	.....	.....	.....	Fig. 20
2	".....	R	1.500	183	76	41.5	12.2	4.9	.....	Alleged age 16	L	240	88	36.6	16.0	5.8	I	.....	.....	IV/V	.....	Fig. 21
										Fig. 7												

In one case the second toe is the longest. An interstice between the first and second toe occurs in two cases; the concave incurvation of the foot in two cases.

An outstanding first toe, together with a more or less fan-like spreading of the third and fifth toes, occurs once. Two hands and one foot belong to the broad type; one hand and two feet pertain to the elongated form. As for the Bush Negro females, it will suffice to say that their hands, but specially their feet, and these latter in a marked degree, are long and narrow. This is not only evidenced by the index and the centesimal ratio to stature, but morphologically also by their long and narrow type. In other words, both show characteristics which are found in certain groups of African Negroes.

SUMMARY OF THE PRINCIPAL GENERAL RESULTS

Scanty as the preceding data are, I think we are nevertheless justified in drawing certain conclusions which, of course, have only a relative value, and should not necessarily lead to generalizations. I shall refrain from comparisons with other races, as far as this would be possible with the material brought together in the well-known handbooks of Topinard and Rudolf Martin and with the observations of a few field anthropologists in the Indian Archipelago, further Oceania and elsewhere.

Although there is an enormous difference in the absolute measurements or dimensions of the North and South American Indians of both sexes, the relative measurements present on the whole only very slight differences.

The greatest differences, although not considerable, lie in the hand and foot indices of the male and female North and South American Indians. In other words, the hands and feet of the latter are mostly larger, both according to the indices as well as in relation to stature ($= 100$). This fact is fully confirmed by the relative prevalence of short, broad hands and feet among them; the North American Indians having proportionately longer and slenderer hands and feet.

The metatarso-phalangeal or anterior portion in relation to the

calcaneal or posterior part is very broad and comparatively much larger among the South American Indians. These hand and foot types are doubtless in correlation with the height of body or stature, the North American Indians being on the whole much taller than the South American Indians. As for the other differences, metrical and morphological, of the two groups, there is generally more difference in the mutual length of the fingers, more particularly of the second and fourth, among the North American Indians.

The second toe exceeds the first more frequently in length among the South American Indians.

The outward deviation of the first toe, the more or less fan-like disposition of the other toes, and the interstices between them are also more frequent among the South American Indians, as well as the concave incurvation of the foot.

The hands and feet of the Indian Carbugres resemble in most respects those of the full-blood Indians.

The difference in the disposition of the toes, including the interstices, can perhaps, at least partly, be explained by two main factors, footgear and mode of life. The Indians of the Southwest and of Northern Mexico do not always go barefooted, but they frequently wear sandals or, like the Chemehuevi and Paiute, also moccasins. The ground they tread is mostly composed of sandy plains or barren rocks. Besides the narrow dugout canoes of tropical South America are unknown to them. Except on Colorado river canoes are never used, and even there they are not very common.

The natives of tropical South America on the contrary have no footgear whatever. The forest trails are very narrow; oftener still there are no trails at all, and when the Indians go through the dense forest, they move slowly, with difficulty. But, what is more important, they pass a part of their existence in canoes. The mode of living and the surroundings of the South American natives, at least in the tropical regions, are in many respects very similar to those of the primitive natives, brown or black, of the Malay Peninsula, the Indian Archipelago, the Philippines, and further Oceania, where the same characteristics of the feet frequently occur.

As to the general muscular development of the hands in both sexes, it would seem that on the whole, and in relation to the stature, it is about equal among the North and South American Indians, notwithstanding the difference in pressure as revealed by the dynamometer.¹ Both groups and both sexes have hands developed by and used to constant exercise, either by handling various weapons and paddles, or by tilling the soil.

The muscular development of the feet, in correlation with that of the legs, however, generally seems to be in favor of the North American Indians, males and females. This discrepancy is probably partly due to the fact that, as I said before, many South American Indians pass a part of their life in canoes, which prevents the full development of the lower limbs. Furthermore foot races, ball and other games, in which these limbs are exercised, so common among the tribes of the Southwest, are unusual or unknown among the forest Indians of South America.²

ASHIYA, JAPAN

¹ Cf. "Dynamometric Observations," *loc. cit.*

² The above remarks on muscular development are not only based on the present material but also on numerous observations made in the field.